

Appendix A: Alphabetical List of Biotechnology Occupations

Animal Handlers	51
Animal Technicians	53
Assay Analysts	65
Biochemical Development Engineers	67
Bioinformatics Specialists	55
Biostatisticians	57
Clinical Research Associates	59
Customer Service Representatives	113
Documentation Coordinators	85
Documentation Specialists	87
Graphic Designers	115
Greenhouse Assistants	37
Instrumentation/Calibration Technicians	69
Laboratory Assistants	39
Laboratory Support Workers	41
Library Assistants	107
Manufacturing Engineers	71
Manufacturing Research Associates	73
Manufacturing Technicians	77
Medical (Technical) Writers	61
Microbiologists	91
Plant Breeders	43
Process Development Associates	77
Process Development Engineers	79
Production Planners and Schedulers	81
Quality Assurance Auditors	93
Quality Control Analysts	95
Quality Control Engineers	97
Quality Control Inspectors	99
Research Associates (R&D)	45
Research Scientists	47
Safety Specialists	101
Sales Representatives	117
Scientific Programmer Analysts	109
Technical Service Representatives	119
Validation Technicians	103

Appendix B: Crosswalk Biotechnology Industry Classifications from SIC system to NAICS system

Biotechnology firms are found in several industry groups. The 2002 North American Industrial Classification System (NAICS) classifies establishments into industries based on their primary activities. This system recently replaced the federal Standard Industrial Classification (SIC) system, which, for the most part, grouped biotechnology firms among either research and testing facilities or drug manufacturing. Below is an illustration linking the old SIC industry titles related to biotechnology to the corresponding NAICS industries.

Standard Industrial Classification

North American Industrial Classification

Drugs
(SIC 283)



Chemical Manufacturing
(NAICS 325)

Research and Testing Services
(SIC 873)



Professional, Scientific, and Technical
Services (NAICS 541)

Industries with minor representation

In small numbers, biotechnology firms are found in several other industries, doing activities such as manufacturing specialized equipment for biotechnology products or providing engineering services.

Measuring and Controlling
Devices (SIC 382)



Computer and Electronic Product
Manufacturing (NAICS 334)

Medical Instruments and
Supplies (SIC 384)



Computer and Electronic Product
Manufacturing (NAICS 334)

Miscellaneous Manufacturing
(NAICS 339)

Professional and Commercial
Equipment (SIC 504)



Merchant Wholesalers, Durable Goods
(NAICS 423)

Drugs, Proprietarys, and
Sundries (SIC 512)



Merchant Wholesalers, Nondurable Goods
(NAICS 424)

Medical and Dental
Laboratories (SIC 807)



Miscellaneous Manufacturing
(NAICS 339)

Engineering, Architectural,
and Surveying Services (SIC 871)



Professional, Scientific, and Technical
Services (NAICS 541)

Management and Public
Relations (SIC 874)



Professional, Scientific, and Technical
Services (NAICS 541)

Appendix C: Outlook for Occupations by Education Level for Largest Biotechnology Industries

Biotechnology Occupations	Research & Testing Employment		Drug Manufacturing Employment		Total Employment, All Industries		Interest Area (RIASEC**)
High School Degree	2000	2010	2000	2010	2000	2010	
Animal Handlers	100	100	NA	NA	9,200	12,300	Realistic
Library Assistants	NA	NA	NA	NA	7,900	10,000	Conventional
Documentation Coordinators	2,300	3,300	500	700	363,400	433,000	Conventional
Greenhouse Assistants	1,600	2,200	700	1,000	17,700	21,800	Realistic
Laboratory Support Workers	NA	NA	100	100	62,800	61,400	Realistic
Quality Control Inspectors	1,600	2,300	1,900	2,200	69,300	68,300	Investigative
Associate Degree or Certificate	2000	2010	2000	2010	2000	2010	
Animal Technicians	200	300	NA	NA	5,200	7,500	Realistic
Assay Analysts*	5,800	8,900	2,200	3,200	11,900	16,100	Realistic
Instrumentation/Calibration Technicians*	2,700	3,800	1,900	2,200	104,300	107,600	Realistic
Laboratory Assistants	5,200	7,800	1,900	2,700	21,000	26,900	NA
Manufacturing Technicians*	1,600	2,000	7,400	9,900	196,500	213,600	Realistic
Validation Technicians	1,600	2,300	1,900	2,200	69,300	68,300	Realistic
Bachelor's Degree	2000	2010	2000	2010	2000	2010	
Biochemical Development Engineers	300	400	300	500	2,800	3,400	Investigative
Clinical Research Associates*	5,200	7,200	1,100	1,700	15,500	19,900	Investigative
Customer Service Representatives	1,000	1,400	400	600	199,500	267,300	Conventional
Documentation Specialists	600	900	200	300	40,000	53,500	Investigative
Graphic Designers	300	400	100	100	19,400	25,000	Artistic
Manufacturing Engineers	400	500	200	200	19,800	21,000	Enterprising
Manufacturing Research Associates*	9,500	13,900	2,900	4,400	36,000	43,600	Investigative
Medical (Technical) Writers	400	500	NA	NA	7,300	9,500	Artistic
Microbiologists	800	1,300	800	1,100	2,200	3,100	Investigative
Plant Breeders	600	800	NA	NA	4,900	6,000	Investigative
Process Development Associates*	5,300	7,300	1,800	2,800	30,100	34,700	Enterprising
Process Development Engineers*	700	900	500	700	22,600	24,400	Realistic
Production Planners/Schedulers*	400	500	600	800	69,700	79,500	Enterprising
Quality Assurance Auditors	300	300	200	200	5,800	6,500	Investigative
Quality Control Analysts	300	300	200	200	5,800	6,500	Investigative
Quality Control Engineers	400	500	200	200	19,800	21,000	Enterprising
Research Associates (R&D)*	12,100	17,500	2,900	4,400	27,400	36,800	Investigative
Safety Specialists	NA	NA	NA	NA	2,100	2,600	Social
Sales Representatives	400	400	500	600	44,600	50,800	Enterprising
Scientific Programmer Analysts	900	1,500	300	500	48,200	76,600	Investigative
Technical Service Representatives	1,100	1,400	700	1,000	14,600	18,000	NA
Master's Degree	2000	2010	2000	2010	2000	2010	
Bioinformatic Specialists*	2400	4300	100	200	89,300	177,900	Investigative
Biostatisticians	NA	NA	NA	NA	2,300	2,600	Investigative
Doctorate Degree	2000	2010	2000	2010	2000	2010	
Research Scientists	12,100	17,500	2,900	4,400	27,400	36,800	Investigative

*Employment figures are representative of more than one occupational group.

Appendix D: Related Academic Programs in California Colleges and Universities

The following California colleges and universities offering programs related to biotechnology were compiled from the Web resources listed below. Information may be incomplete and is subject to change. Schools should be contacted directly for further information.

- California Training and Education Providers
<http://www.soicc.ca.gov/ctep/>
- California Postsecondary Education Commission, College Guide
<http://www.cpec.ca.gov/CollegeGuide/SearchGuide.asp?C>

Biochemistry

- Azusa Pacific
- Biola University
- California Institute of Technology
- California Lutheran University
- California Polytechnic State University, San Luis Obispo
- California State University, Chico
- California State University, Dominguez Hills
- California State University, Fullerton
- California State University, Hayward
- California State University, Long Beach
- California State University, Los Angeles
- California State University, Northridge
- California State University, San Bernardino
- Claremont McKenna College
- College of San Mateo
- College of the Canyons
- Desert Community College District
- Humboldt State University
- Institute for Creation Research
- La Sierra University
- Loyola Marymount University
- Mills College
- Mount Saint Mary's College
- Notre Dame de Namur University
- Occidental College
- Pacific Union College
- Pepperdine University
- Point Loma Nazarene University
- Saint Mary's College of California
- San Diego State University
- San Francisco State University
- Scripps College
- Sonoma State University
- Stanford University
- University of California, Berkeley
- University of California, Davis
- University of California, Irvine
- University of California, Riverside
- University of California, San Francisco
- University of California, Santa Barbara
- University of California, Santa Cruz
- University of Southern California
- University of the Pacific

Biochemistry/Biophysics and Molecular Biology

- San Francisco State University, College of Extended Learning

Bioinformatics

- Mos Institute of Technology, San Jose
- University of California, Berkeley Extension
- University of California, Santa Cruz Extension

Biological and Physical Sciences

- Barstow Community College District
- California Lutheran University
- California State University, Bakersfield
- California State University, Fullerton

Appendix D: Related Academic Programs in California Colleges and Universities (continued)

Biological and Physical Sciences (continued)

- California State University, Hayward
- California State University, Los Angeles
- California State University, Northridge
- California State University, Sacramento
- California State University, San Bernardino
- California State University, Stanislaus
- Chapman University
- Christian Heritage College
- Citrus College
- College of Alameda
- College of Marin
- College of the Redwoods
- Cuyamaca College
- El Camino College
- Glendale Community College
- Grossmont College
- Imperial Valley College
- Hope International University
- Lake Tahoe Community College
- Laney College
- Los Medanos College
- Loyola Marymount University
- Merritt College
- Moorpark College
- Mt. San Jacinto College
- National University
- Oxnard College
- Pacific Union College
- Saddleback College
- San Diego City College
- San Joaquin College
- San Jose State University
- Santa Ana College
- Santa Monica College
- Sierra College, Nevada County Campus
- Solano Community College
- Sonoma State University
- State Center Community College District, Oakhurst
- University of California, Berkeley Extension
- University of Southern California
- University of the Pacific
- Victor Valley College
- Vista Community College
- Westmont College

Biological Technology/Biological Laboratory Technology

- American River College
- Bakersfield College
- Computer Services and Instruction, Inc.
- DeAnza College
- Foothill College
- Fullerton College
- Reedley College
- San Diego Miramar College
- Santa Barbara City College
- Solano Community College
- University of Judaism
- Vista Community College
- Whittier College

Biology/Biological Sciences

- Allan Hancock College
- American River College
- Antelope Valley College
- Bakersfield College
- Barstow College
- Biola College
- Butte Community College
- Butte-Glenn Community College District
- Cabrillo College
- California Baptist University
- California Institute of Technology
- California Lutheran University
- California State Polytechnic University, Pomona
- California State University, Bakersfield
- California State University, Chico
- California State University, Dominguez Hills
- California State University, Fresno
- California State University, Fullerton

Appendix D: Related Academic Programs in California Colleges and Universities (continued)

Biology/Biological Sciences (continued)

- California State University, Hayward
- California State University, Long Beach
- California State University, Los Angeles
- California State University, Northridge
- California State University, Sacramento
- California State University, San Bernardino
- California State University, San Marcos
- California State University, Stanislaus
- Canada College
- Cerritos College
- Cerro Coso Community College
- Chabot College
- Chaffey Community College
- Chapman University
- Christian Heritage College
- Citrus College
- Claremont McKenna College
- College of Alameda
- College of Marin
- College of San Mateo
- College of the Canyons
- College of the Desert
- College of the Redwoods
- College of the Siskiyous
- Columbia College
- Concordia University
- Contra Costa College
- Crafton Hills College
- DeAnza College
- Desert Community College District
- Dominican University of California
- East Los Angeles College
- El Camino College
- EvergreenValleyCollege
- Feather River College
- Foothill College
- Fresno City College
- Fresno Pacific University
- Fullerton College
- Gavilan College
- Glendale Community College
- Grossmont College
- Hartnell College
- Harvey Mudd College
- Holy Names College
- Humboldt State University
- Imperial Valley College
- Irvine Valley College
- La Sierra University
- Lake Tahoe Community College
- Las Positas College
- Loma Linda University
- Long Beach City College
- Los Angeles Harbor College
- Los Angeles Southwest College
- Los Angeles Valley College
- Los Medanos College
- Loyola Marymount University
- Master's College, The
- Mendocino College
- Merced College
- Mills College
- Mira Costa College
- Mission College
- Modesto Junior College
- Monterey Peninsula College
- Moorpark College
- Mount Saint Mary's College
- Mt. San Jacinto College
- Napa Valley College
- Notre Dame de Namur University
- Occidental College
- Ohlone College
- Oxnard College
- Pacific Union College
- Palo Verde College
- Palomar College
- Pasadena City College
- Pepperdine University
- Pitzer College
- Point Loma Nazarene University
- Pomona College
- Porterville College
- Riverside Community College

Appendix D: Related Academic Programs in California Colleges and Universities (continued)

Biology/Biological Sciences (continued)

- Sacramento City College
- Saddleback College
- Saint Mary's College of California
- San Bernardino Valley College
- San Diego City College
- San Diego Mesa College
- San Diego Miramar College
- San Diego State University
- San Francisco City College
- San Joaquin Delta College
- San Jose City College
- Santa Ana College
- Santa Barbara City College
- Santa Clara University
- Santa Monica College
- Santa Rosa Junior College
- Scripps College
- Shasta College
- Sierra College
- Skyline College
- Solano Community College
- Sonoma State University
- Southwestern College
- Stanford University
- University of California, Berkeley
- University of California, Davis
- University of California, Irvine
- University of California, Los Angeles
- University of California, Riverside
- University of California, San Diego
- University of California, Santa Barbara
- University of California, Santa Cruz
- University of La Verne
- University of Redlands
- University of San Diego
- University of San Francisco
- University of Southern California
- Ventura College
- Vista Community College
- West Hills College
- West Los Angeles College
- West Valley College
- Westmont College
- Whittier College
- Yuba College

Biomedical Electronic Equipment Technology

- California State Polytechnic University, San Luis Obispo
- Cerritos College
- Los Angeles City College
- Los Angeles Valley College
- Napa Valley College
- San Francisco State University, College of Extended Learning
- San Joaquin Delta College
- Santa Barbara City College

Biomedical/Medical Engineering

- California Polytechnic State University, San Luis Obispo
- California State University, Long Beach
- University of California, Berkeley
- University of California, Davis
- University of California, San Diego
- University of California, San Francisco
- University of Northern California

Biometry/Biometrics

- San Diego State University
- University of California, Berkeley
- University of Southern California

Appendix D: Related Academic Programs in California Colleges and Universities (continued)

Biophysics

- California State University, Los Angeles
- Pacific Union College
- Stanford University
- University of California, Berkeley
- University of California, Davis
- University of California, Irvine
- University of California, San Diego
- University of California, San Francisco
- University of Southern California

Biostatistics

- Chabot College
- Institute for Creation Research
- Loma Linda University
- University of California, Berkeley
- University of California, Los Angeles

Biotechnology/Biotechnology Research

- American River College
- California State Polytechnic University, Pomona
- California State University, Los Angeles, Continuing Education
- City College of San Francisco
- College of the Canyons
- Hope International University
- Mira Costa College
- Occupational Training Institute
- Regional Training and Technical Center
- Riverside Community College
- Skyline College
- San Francisco State University
- University of California Extension, Berkeley
- University of California, Davis
- University of California, Irvine
- University of California Extension, San Diego
- University of California Extension, Santa Cruz
- Ventura College
- Vista Community College

Industrial and Manufacturing Engineering

- California Polytechnic State University, Pomona
- California Polytechnic State University, San Luis Obispo
- California State University, Fresno
- California State University, Los Angeles
- California State University, Northridge
- Cerritos College
- Chabot College
- ITT Technical Institute, Lathrop
- ITT Technical Institute, Oxnard
- ITT Technical Institute, San Bernardino
- Los Angeles Valley College
- San Jose State University
- Stanford University
- University of California, Berkeley
- University of California, San Diego
- University of San Diego
- University of Southern California

Laboratory Technology

- Merced College

Appendix D: Related Academic Programs in California Colleges and Universities (continued)

Medical Laboratory Technology

- American College of Medical Technology
- Bryman College
- El Camino College
- Los Angeles Valley College
- Merced College
- Newbridge College
- Pasadena City College
- San Joaquin Delta College
- San Joaquin Training Institute, Inc.
- San Jose State University
- West Valley College

Medical Microbiology and Bacteriology

- California Polytechnic State University, San Luis Obispo
- California State Polytechnic University, Pomona
- California State University, Chico
- California State University, Long Beach
- California State University, Los Angeles
- California State University, Northridge
- California State University, Stanislaus
- Cerritos College
- College of San Mateo
- East Los Angeles
- Humboldt State University
- Loma Linda University
- Los Angeles City College
- Modesto Junior College
- San Diego State University

Medical Technology

- Loma Linda University
- Pacific Union College

Microbiology

- California Polytechnic State University, Pomona
- California Polytechnic State University, San Luis Obispo
- California State University, Chico
- California State University, Fresno
- California State University, Long Beach
- California State University, Los Angeles
- California State University, Stanislaus
- College of the Canyons
- East Los Angeles College
- Institute for Creation Research
- Loma Linda University
- National Environmental
- San Diego State University
- San Jose State University
- Shasta College
- Stanford University
- University of California, Berkeley
- University of California, Davis
- University of California, Irvine
- University of California, Los Angeles
- University of California, San Diego
- University of California, San Francisco
- University of California, Santa Barbara
- University of Southern California
- Vista Community College

Appendix E: Education and Training Requirements for Biotechnology Careers

Biotechnology Occupations	Education	Work Experience
Animal Handlers	High school diploma	Possess up to two years of laboratory experience (exp.)
Animal Technicians	Certificate or associate degree	Certification as an Assistant Laboratory Animal Technician by the American Association for Laboratory Animal Science is preferred
Assay Analysts	Associate or bachelor's degree in a science	Up to two years of exp. in sterile manufacturing environment
Biochemical Development Engineers	Bachelor's or master's degree in chemical or biochemical engineering	Up to two years of exp. in pharmaceutical processes
Bioinformatics Specialists	Master's or doctorate degree in bioinformatics, computer engineering, computational biology	Up to two years of related exp.
Biostatistician	Master's or doctorate in mathematics or statistics	Possess one to four years related exp.
Clinical Research Associates	Bachelor's or master's degree in life sciences, health field, or Registered Nurse degree	Possess up to two years exp. in medical research pharmaceutical research
Customer Service Representatives	Bachelor of arts or science degree	Up to two years related exp.
Documentation Coordinators	High school diploma or associate degree	Up to two years of exp. in documentation, quality control
Documentation Specialists	Bachelor of science degree in scientific field	Three to five years exp. in documentation, quality control, or quality assurance
Graphic Designers	Bachelor's in Graphic Design	One to four years related exp.
Greenhouse Assistants	High school diploma or associate degree	Possess up to two years of greenhouse or plant exp.
Instrumentation/Calibration Technicians	Certificate or associate degree in biotechnology, electronics, instrumentation	One to two years of exp. in quality control systems
Laboratory Assistants	Certificate or associate degree in the laboratory sciences	Have up to two years of laboratory exp.
Laboratory Support Workers	High school diploma or associate degree	Up to two years of work exp.
Library Assistants	High school diploma	Possess up to two years of relevant library exp.
Manufacturing Engineers	Bachelor of science degree in a science-related field	Up to two years exp. in research product development
Manufacturing Research Associates	Bachelor or master of science degree in engineering or one of the life sciences	Up to two years of exp. in a manufacturing environment
Manufacturing Technicians	Certificate or associate degree in biotechnology	Several years of exp. in sterile manufacturing environment

Appendix E: Education and Training Requirements for Biotechnology Careers

Biotechnology Occupations	Education	Work Experience
Medical Writers (Technical Writers)	Bachelor's or graduate degree in life sciences	California colleges and universities offer certificates in technical writing
Microbiologists	Bachelor or master of science degree in microbiology	Work exp. desired
Plant Breeders	Bachelor of science degree or equivalent	Up to two years of exp. in plant breeding or agronomics
Process Development Associates	Bachelor or master of science degree in biosciences or other scientific disciplines	Up to two years exp. in manufacturing
Process Development Engineers	Bachelor or master of science in biosciences or in electrical/mechanical engineering	Up to two years of related exp.
Production Planners	Bachelor of science degree in biological or physical sciences almost always required	Two years manufacturing exp.
Quality Assurance Auditors	Bachelor of science degree in bioscience	Up to two years of exp. in biological or pharmaceutical manufacturing
Quality Control Analysts	Bachelor or master of science degree in biological sciences or another scientific discipline	Possess up to two to five years of exp.
Quality Control Engineers	Bachelor or master of science degree in engineering	Possess up to two to five years of quality control exp.
Quality Control Inspectors	High school diploma or associate degree in biotechnology or health related field	One to two years of exp. in quality control systems
Research Associates (R&D)	Bachelor or master of science degree in the sciences	Possess up to two years of laboratory exp. with master of science or two to five years with bachelor of science degree
Research Scientists	Doctorate degree in biological sciences or chemistry with up to five years of exp. in a research environment	Up to two years of exp.
Safety Specialists	Bachelor of science degree in a life science, chemistry, or industrial hygiene	Possess up to two years of related exp.
Sales Representatives	Bachelor of arts or science degree	Up to two years related exp.
Scientific Programmer Analysts	Bachelor of science degree in computer science, engineering, or a scientific discipline	Possess up to two years of related exp.
Technical Service Representatives	Bachelor or master of science degree	Up to two years of related exp.
Validation Technicians	Associate of arts or bachelor of science degree in biotechnical or related health science field	Bachelor of science degree in chemistry, biology, or engineering for supervisory or management positions

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Aon Consulting/Radford Surveys

Sources for Biotechnology Career Exploration

The following information sites offer a wealth of information to those exploring a career in biotechnology. Career guides, news articles on trends in the industry, training sources, and even directories of employers in the country. Much of this information is free of charge, although some sites do charge for print publications or an employer directory.

California Careers in Biotechnology, 2nd Edition

A Counselor's Guide to the Best Jobs (2002)

By Gina Frierman-Hunt and Julie Solberg

www.cccbitech.org

Biotechnology Industry Organization

<http://www.bio.org/welcome.html>

BioScience Education and Training Program Directory

By Judith Leff and Maura O'Dea

Education Development Center, Inc.

<http://www.edc.org/>

American Society for Biochemistry and Molecular Biology

<http://www.asbmb.org/>

American Society for Microbiology

<http://www.asm.org/>

Biocom

www.biotech-resource.com

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